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UNITED STATES
DEPARTMENT OF AGRICULTURE
DEPARTMENT CIRCULAR 249

Washington, D. C.

Issued December, 1922
Revised November 1936

TUBERCULIN TESTING OF LIVESTOCK [1]

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IMPORTANCE OF TUBERCULOSIS ERADICATION

Tuberculosis of the food-producing animals was at one time the most serious disease with which the American farmers were confronted. Realization of this fact resulted in the organization of the cooperative campaign for its control and eventual eradication between the United States Bureau of Animal Industry, the State livestock sanitary officials, the livestock owners of the Nation, and other persons interested in the livestock industry. When this eradication plan was proposed there was much doubt as to the feasibility of such a comprehensive method of testing. There were some who stated that the plan could not be carried on with any degree of success, but by June 1936 more than 95 percent of the total number of counties in the United States had practically eradicated the disease among cattle.

When the work was first undertaken the testing was done with individual herds under what is known as the accredited-herd plan. Within a comparatively short time, however, consideration was given to broadening this plan to permit the testing of all cattle in a definite area, a method which became known as the area plan.

In order to make the tuberculosis-eradication plan a success it was, of course, necessary to have a clear conception of the disease and the various methods by which it is disseminated. Important phases of the tuberculosis problem have been the subject of articles and discussion by scientists since Robert Koch discovered the active cause

[1] This is a revision of former editions by L. B. Ernest (retired) and Elmer Lash.

of the disease and later prepared the biological product known as tuberculin. In the literature and discussions for many years much thought has been given to the methods advocated for the detection of the disease. These methods are chiefly interesting to the veterinarian who desires definite knowledge of those which are recommended and which have proved to be successful.

Various methods of diagnosing tuberculosis in the living animal have been proposed, such as the physical examination, use of the sputum cup, animal inoculation, laboratory examination of milk and feces, and the use of tuberculin. This circular deals only with the various tuberculin-test methods that are used in the United States. The other methods have their value when used in conjunction with tuberculin testing, but cannot be relied upon alone to detect all tuberculous animals in infected herds. In presenting data relative to methods of testing, the experience gained by veterinary inspectors engaged daily in tuberculin testing is the best index for the substantiation of the instructions and suggestions made here. The methods advocated and results reported have met with the approval of livestock owners who have placed their herds under the joint supervision of the Bureau of Animal Industry and State forces. During the 19 years from June 1917 to June 1936, more than 176,000,000 tests of cattle were made under both plans of testing and from this number approximately 3,450,000 reactors were removed. This large volume of testing not only shows how favorably the livestock owners have responded in this cooperative effort but it also affords an excellent opportunity for a careful study of the various tests and the results to be expected from their proper application.

NATURE OF TUBERCULIN

The diagnostic agent, tuberculin, has been prepared in a variety of forms, chiefly governed by the intended manner of its application to the animal to be tested. After the basal work of Koch in 1890 the product—provided of course that it is properly prepared and properly used by persons qualified to evaluate its effects—soon became accepted as a remarkably accurate method for the detection of tuberculosis, even in very early stages of the disease.

Essentially, tuberculin contains certain products derived from the growth of *Mycobacterium tuberculosis* on an artificial culture medium, but not the living organisms themselves. Its diagnostic sphere differs somewhat according to whether the organisms employed for its production are of the human, bovine, or avian type. Its final form and concentration will depend on the method—the intradermic, subcutaneous, or ophthalmic—by which it is to be administered to the animal.

Naturally, the passing years have witnessed improvements over the original tuberculin of Koch. The contribution of the Bureau of Animal Industry in this respect was the development in 1928 of an improved synthetic culture medium which is composed entirely of pure organic chemicals and mineral salts. Abundant growth of the organism, high and uniform potency of the product, comparative freedom from inert matter carried over from the culture medium, and sharper diagnosis, as well as economy in the cost of production, are its advantages.

QUALIFICATIONS OF THE VETERINARIAN

In studying the history of tuberculosis and the use of tuberculin, the conclusion is drawn that in the past tuberculin testing was regarded by many as a routine operation which required little skill in its application or interpretation of the results obtained. This idea is a fallacy and should not be entertained. Tuberculin is a very reliable agent and in the hands of the experienced veterinarian will give accurate results. One should remember that in order to obtain the best results a close study of the action of tuberculin is necessary, and in addition the necessary instruments for the proper conduct of the tests should be available. From observation of the work of many men it is deemed necessary to emphasize the close relationship between reliable testing and the accurate conscientious operator. So minute should be the study of the work in hand as to lead not only to a study of the herd under test but also of each individual animal in the herd. Only by such attention to details will the desired results be accomplished.

METHODS OF TUBERCULIN TESTING

There are three principal methods of applying the tuberculin test: (1) The subcutaneous, or "thermal", test; (2) the intradermic, or "skin", test; and (3) the ophthalmic, or "eye", test. Only the first two are recognized as official tests by the Bureau of Animal Industry and various State officials. The subcutaneous test is the first one to be put into general use in this country but it is now almost entirely replaced by the intradermic test in official tuberculosis-eradication work. There is a form of the intradermic test, known as the intrapalpebral test, in which the injection is made into the skin of the lower eyelid instead of into the caudal fold as is done in the majority of intradermic tests.

Accurate records of the work are kept by Bureau officials, and close study has been given to the results obtained. Used under the proper conditions, any tuberculin test properly applied is remarkably accurate and practically all the results obtained in the testing of animals are either positive or negative diagnoses. It is only in a very small percentage of cases that a state of doubt will exist. In those herds believed to be free from disease, it is better judgment to class all doubtful cases as suspicious.

THE SUBCUTANEOUS TEST

The subcutaneous method of testing consists in the injection of a given dose of tuberculin under the skin of the animal. Most operators prefer the skin above the point of the shoulder as the seat of injection; however, any convenient point may be selected. This test is but little used at the present time except on interstate shipments where it is necessary to ship the animals before the lapse of 3 days which is required when the intradermic test is applied. Until March 1, 1920, the subcutaneous test was the only method officially recognized by the Bureau of Animal Industry. The history of its application for many years indicates that in the hands of competent individuals it is very reliable. More recent study and the use of another method has shown that the subcutaneous test probably lends

itself more to the assistance of those who desire to defeat its ends than does the other test. It is probably most accurate when used on animals for the first time. D. E. Salmon, former Chief of the Bureau of Animal Industry, stated in 1906:

> The first test of a herd with tuberculin, combined with the physical examination of the individual animals, may be accepted as reliable in its indications not only as to the existence of tuberculosis in the herd but also as to the healthfulness of the various animals composing the herd.

A different aspect is presented in testing animals which have been frequently tested and which have established a tolerance to tuberculin. Under these conditions many of the so-called failures of this test have become apparent. Many of these failures of diagnosis can be attributed to the operators' failure to recognize slight reactions or in expecting to find what is termed a characteristic or

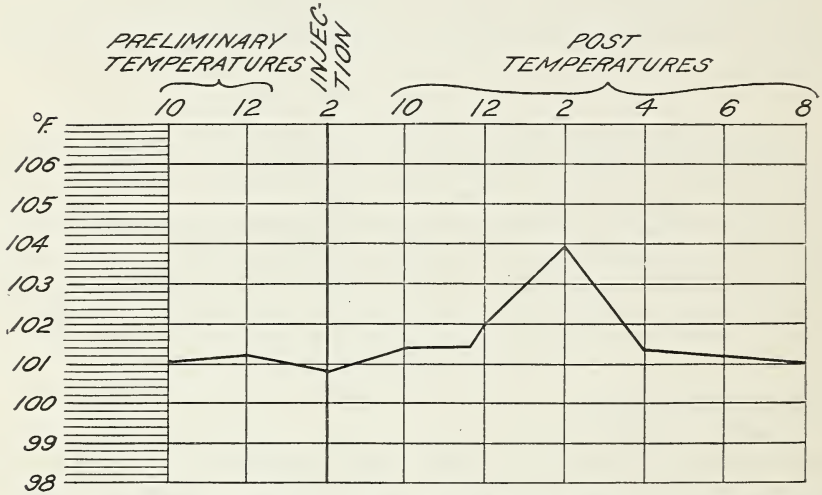

FIGURE 1.—Subcutaneous-tuberculin-test chart showing sudden rise and fall of temperature between second and fourth post temperatures. This animal should normally be classified as suspicious unless accompanied by a physical reaction or other evidence of infection, in which case it should be classed as a reactor.

marked reaction. The apparent failures of the test may be classified under two headings: (1) Those not disclosing infected animals which result in leaving diseased cattle in the herd, and (2) the classifying of animals as reactors when a slight thermal disturbance may be due to other causes. This results in healthy animals being classified as diseased. The latter class is the less important. It is those animals which are diseased and which are left in the herd that cause a continuing infection. In using the subcutaneous test on cattle which have been apparently immunized against the action of tuberculin it should be used only with another method in combination, and larger doses of tuberculin should be employed.

In applying the subcutaneous test it is very essential that veterinarians make careful observations to note the possible physical reaction which sometimes becomes apparent in addition to the thermal reaction, or which may occur when no temperature rise is indicated. Physical disturbances, however, are rather frequent in diseased cattle

which have received several injections of tuberculin. This physical reaction is usually manifested by one or more of the following symptoms: Depression, trembling, bloat, chill, loss of appetite, suspended rumination, difficult breathing, diarrhea, cold extremities, thirst, soreness at the point of injection, and others.

A veterinarian should not hesitate to designate as tuberculous an animal that gives a typical reaction to the subcutaneous test (figs. 3 and 4). However, judgment must be used in classifying animals as reactors under conditions in which a reasonable doubt exists as to their condition. This judgment is acquired as the result of proper training and practical experience. Figures 1 to 6 show the different types of reactions and how they may be classified under varying conditions.

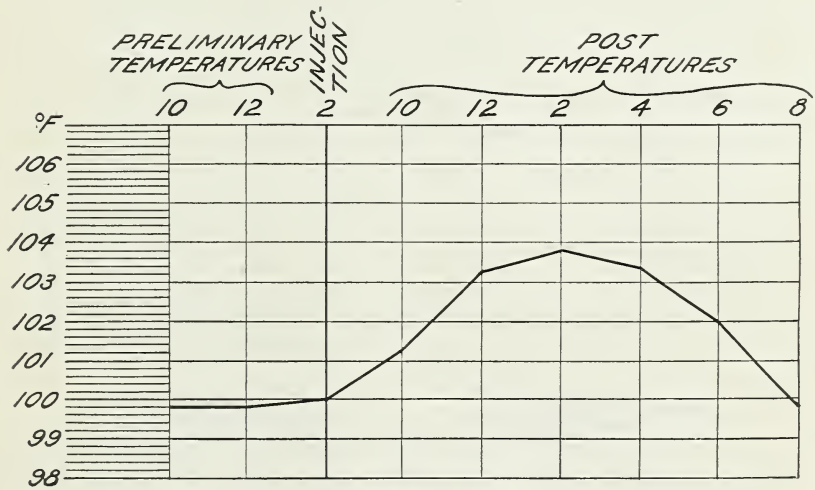

FIGURE 2.—A typical subcutaneous-test curve with a maximum temperature which, according to a strict interpretation of instructions, would necessitate classifying an animal as suspicious. However, if the animal is aged and in poor condition and in a tuberculous herd, it should under those conditions be classified as a reactor. (Note that temperatures are not so high as in figure 3.)

ADVANTAGES AND DISADVANTAGES

The advantages and disadvantages of the subcutaneous method of testing are as follows:

Advantages.—It entails more detailed information upon the test records, necessitating the constant attention of the veterinarian and resulting in a very close study of the herd and animals under test. It lends itself readily to combination with the intradermic method. It is usually very accurate when applied to an animal or herd for the first time.

Disadvantages.—The erratic temperatures sometimes found in very young animals make it inadvisable to use this test upon them or upon animals which are hard to restrain. The constant attention which it necessitates makes for physical hardship upon the veterinarian. It is slower than other methods, as the taking of temperatures requires constant attention, thus limiting the testing to a smaller number of cattle at one time, with consequent increase in the cost.

DIRECTIONS FOR APPLYING

The following gives in detail the technique of the subcutaneous method of testing:

1. So far as practicable the cattle should be stabled under usual conditions and with usual surroundings.

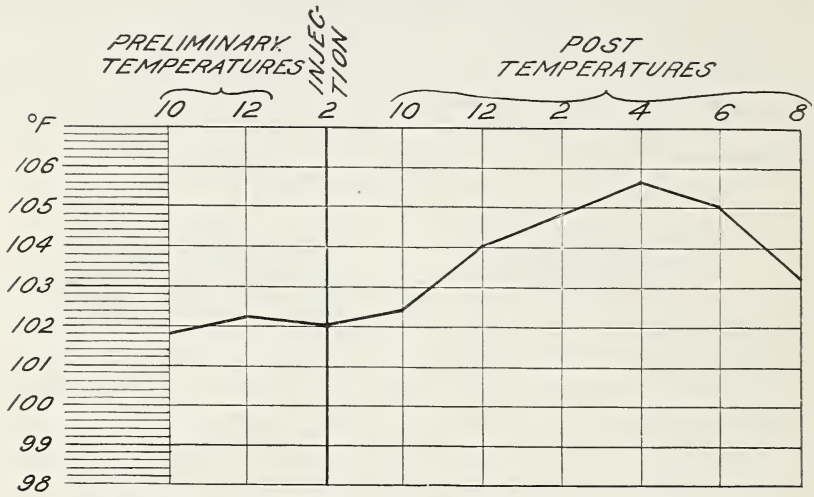

FIGURE 3.—A so-called typical "rainbow" curve, indicating tuberculosis.

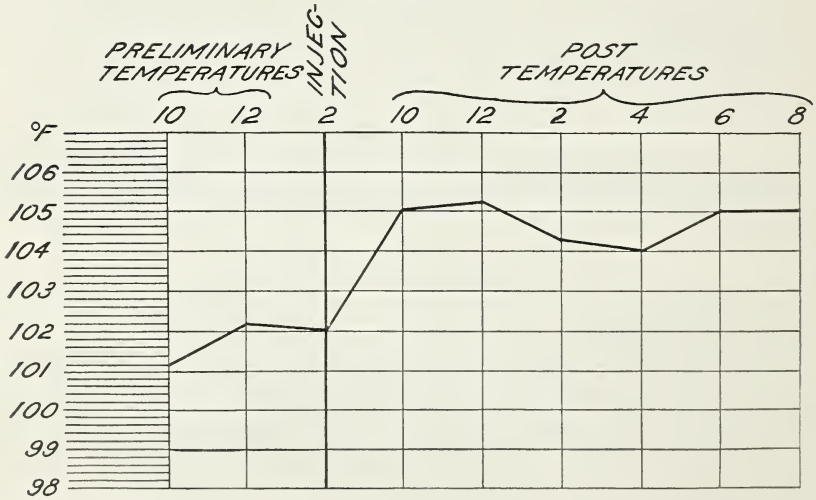

FIGURE 4.—Type of temperature curve called the "plateau", indicating tuberculosis.

2. The cattle should be fed and watered in the customary manner, except that it should be done immediately after the taking of temperatures. Occasionally it is advisable to limit the quantity of concentrated feed or hay given animals under test. This is especially true if large quantities of feed are allowed.

3. A careful physical examination of each animal should be made before or during the application of the test.

4. During the period immediately before the injection of tuberculin each animal's temperature should be taken at least three times at not less than 2-hour intervals. Care should be taken to let the thermometer remain inserted long enough to insure accurate registration.

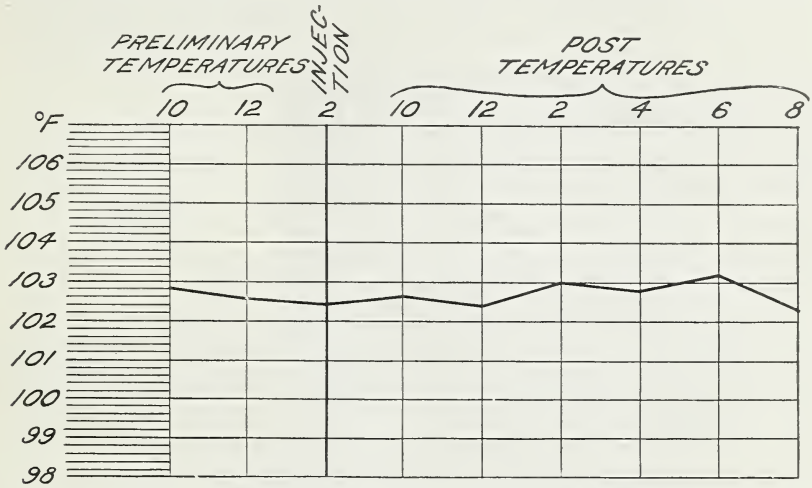

FIGURE 5.—Temperature curve having a maximum of only 0.4° F. between the highest preinjection and postinjection temperatures. An animal showing such a temperature should normally be classified as healthy.

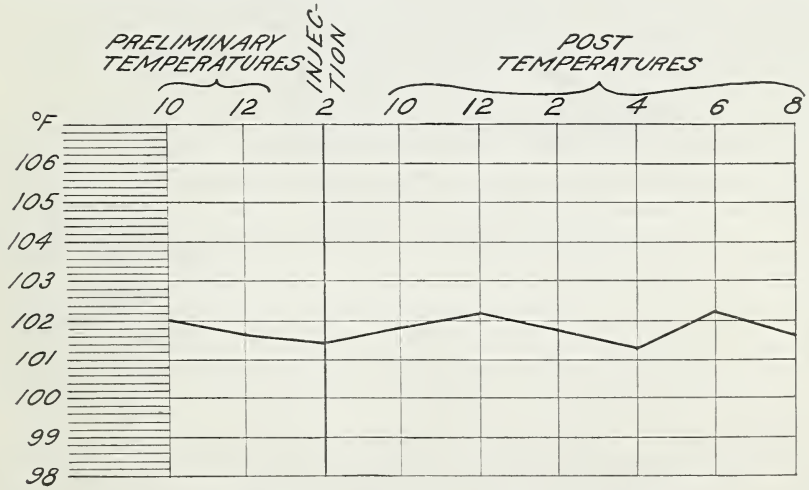

FIGURE 6.—Temperature range of the average healthy animal.

5. Animals showing evidence of any acute disease or condition or showing pus formation or pronounced abnormal preliminary temperature should not be injected with tuberculin. Inquiry concerning the history of the herd should be made, and it should be ascertained, if possible, whether any animal in the herd has ever given a positive reaction to tuberculin, the number of tuberculin tests applied to the

herd previously, and also whether any cattle in the herd have been treated at any time in any other manner with tuberculin. Any reactor to a previous test should not be retested. The information thus obtained should be used in determining the method to be employed in the tuberculin testing of the herd.

6. The hypodermic syringes and needles should be disinfected before treating any herd with tuberculin. Before being used for the injection of each animal needles should be washed in a disinfectant solution. A 5-percent solution of carbolic acid is suitable for sterilizing the instruments. Open bottles of tuberculin should be protected from contamination.

7. Thermometers should be sterilized before the temperatures are taken and should be dipped in a disinfectant solution before and after each reading.

8. The normal dose of strictly subcutaneous tuberculin is as follows:

Two cubic centimeters for calves up to 1 year of age.
Four cubic centimeters for cattle 1 year old or older.

But the Bureau of Animal Industry no longer produces subcutaneous tuberculin as such. It differs from intradermic tuberculin merely in being one-half as concentrated. Therefore intradermic tuberculin may be employed for the subcutaneous test in the following normal dose:

One cubic centimeter for calves up to 1 year of age.
Two cubic centimeters for cattle 1 year old or older.

The normal dose is appropriate for animals which are apparently healthy and which have not been injected with tuberculin within a period of 60 days. Older animals, repeatedly tested animals, or those clinically suspicious, should be given a larger dose. The dose is accordingly based on the age of the animal and its history, rather than on its weight.

9. The taking of temperatures following the injection of tuberculin should commence not later than the eighth hour and be continued every 2 hours until the eighteenth hour after injection when, if there is no tendency for the temperature to rise, the test may cease. Temperatures of cattle which show a rising tendency following the injection of tuberculin should be taken more frequently and over a longer period of time in order to insure an accurate diagnosis.

10. Experience has shown that animals, especially those of doubtful record, receiving large doses of tuberculin, may respond early to the test, and inspectors are advised to obtain temperatures wherever practicable at from the fourth to the sixth hour on this class of cattle.

11. Suspected cattle should be submitted to a retest after 60 days. This class of cattle and those which show possible physical evidence of tuberculosis, emaciation, old age, or which have been tested repeatedly should receive double the dose of tuberculin indicated above, and should also be check-tested by the intradermic method.

12. A rise of 2° or more above the maximum temperature observed prior to the injection of tuberculin or a temperature above 103.8° F. should be regarded as an indication of tuberculosis provided the tem-

perature reaction shows the characteristic "rainbow" curve (fig. 3). An elevation of temperature higher than 103.8° should also be regarded as an indication of tuberculosis even though the so-called rainbow curve is replaced by what is termed "the plateau" (fig. 4).

13. Animals which after injection show a rise in temperature of 2° with a maximum of between 103° and 103.8° F., as well as those which show a rise of less than 2° with a maximum temperature of 103.8° are regarded as suspicious. The presence of a general systematic reaction or a typical curve should be considered a determining factor in the classification between suspects and reactors.

THE INTRADERMIC TEST

The intradermic method of testing consists in the injection of tuberculin between the layers of the skin. Various points may be selected for the injection but most veterinarians prefer to inject the tuberculin into the skin of the caudal fold (fig. 7) on either side of the tail at a point two-thirds of the distance from the base. Another point of injection, and one which is commonly used by veterinarians. is into the lower third of either lip of the vulva (fig. 8) at the junction of the skin and the mucous membrane. At this point the tuberculin is easily absorbed and it is relatively easy to make observations by comparing the injected with the uninjected lip of the vulva. This injection is used largely in conjunction with an injection into the caudal fold and the two are mentioned as the "double injection." These double injections are frequently termed the "upper" and "lower" injections. The lower injection has been found to be a very effective aid in making a decision in doubtful cases. It is extremely valuable also in detecting generalized cases of tuberculosis of long standing in old animals. Experimental work with this lower injection was conducted by State and Bureau employees prior to March 1, 1920, on which date the intradermic method was recognized as official by the Bureau of Animal Industry. Previous to that time, it had been used for a number of years in California, Missouri, Montana, Texas, other Western States, and Wisconsin.

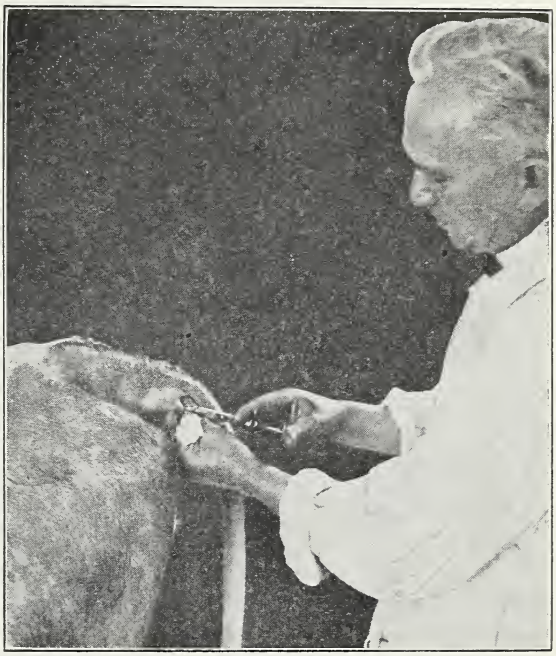

FIGURE 7.—The intradermic injection being made into the caudal fold. The cotton shown between the thumb and finger is first dampened with alcohol and used to cleanse the skin at the point of injection and also to wipe the point of the syringe after each injection.

A form of intradermic testing known as the intrapalpebral test consists in the injection of a minimum dose of tuberculin into the layers of the skin of the lower eyelid. The results obtained from the proper administration of tuberculin by this method are very good. Because of the very delicate nature of the operation, however, and the difficulty in properly restraining animals for the intrapalpebral test, it is not recommended for general use.

There are differences of opinion regarding certain principles of the intradermic test and some lack of uniformity exists as to methods of injection.

The veterinarian will be materially assisted if he observes the following principles in applying the test:

Proper equipment should be available.

Animals should be properly restrained at the time of injection.

The seat of injection should be properly cleansed without the use of irritating disinfectants.

A graduated dose of tuberculin (1 minim) should be used.

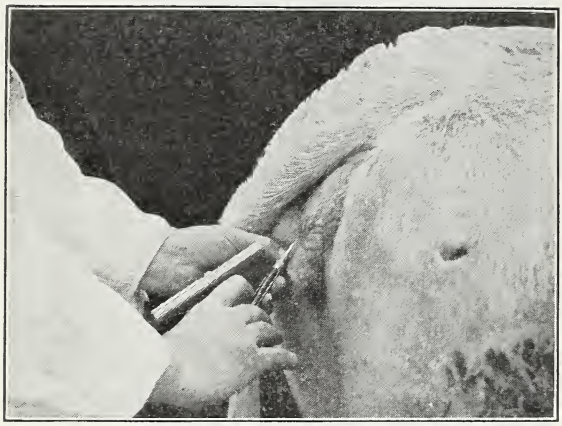

FIGURE 8.—The lower injection of the intradermic test being made with a syringe equipped with an automatic flashlight attachment.

Injections should be made uniformly at approximately the same point in either caudal fold.

A record of all injections should be taken at the time they are made, and special care taken to indicate those which may not be regarded as entirely satisfactory.

Definite periods for observations must be prescribed and a minimum and maximum time observed.

DIRECTIONS FOR APPLYING

1. The operator should provide himself with the following equipment: (*a*) A roll of medicated cotton; (*b*) a suitable syringe, preferably a 25- to 30-minim small-barrel instrument, which should be cleaned and disinfected between tests; (*c*) the needles should be of the Schimmel type, 25 gage and preferably ¼- to ½-inch extension. A shorter needle is advisable in testing animals which are very hard to restrain, such as those of the range type or those which are injected while passing through cattle chutes; (*d*) a bottle of alcohol with which to dampen cotton when wiping needles after each animal has been injected; (*e*) a container which permits the immersion of the syringe and needles in alcohol while going from herd to herd; (*f*) a standard nose lead, with handles, which should be dipped in a disinfectant after its removal from an animal's nose.

2. Cattle should be properly stabled to facilitate the injection.

3. An assistant should properly restrain the animal, if necessary, by the use of a nose lead or by other methods. It is of prime importance to restrain the animal so that it will not move when the needle is inserted.

4. The seat of injection should be cleaned with cotton dampened with alcohol or other cleansing fluid. Disinfectants are not recommended, as they may irritate sensitive skins and cause confusion when observations are made.

5. Both caudal folds and lips of the vulva should be examined and a notation made on test record of any abnormalities or peculiarities.

6. The animal having been restrained and the seat of injection cleaned, the veterinarian by the most convenient method inserts the needle between the layers of the skin, care being taken to inject neither too deeply nor too superficially. If a ½-inch needle is used it is practicable at any time while inserting the needle to verify the accuracy of the injection by slightly lifting the needle, the outline of which will appear under the skin at the point at which the injection is made. Having injected the tuberculin the needle is carefully withdrawn and, if necessary, the finger and thumb of either hand held lightly on the point of injection to prevent the possible escape of any part of the dose. This method of injection causes the least possible disturbance to the tissues involved. The injection is a very important part of the test and should always be done in a careful manner. The injection into the vulva should be made in an equally careful manner.

7. The dose of tuberculin recommended should be about 1 minim of specially prepared intradermic tuberculin, and should be regulated by the gage on the syringe.

8. The first observation should be made on or about the seventy-second hour after injection.

If a second observation is made it should be on the ninety-sixth or one hundred and twentieth hour.

9. Animals should be classified as reactors to the intradermic tuberculin test which show, at the point of either the upper or lower injection, swellings that may be either hard and circumscribed or soft and infiltrated with no distinct line of demarcation. Such swellings may be of various sizes, from those hardly perceptible to the naked eye to those as large as a human fist or larger (fig. 9). In herds showing infection very small infiltrations or enlargements, other than the shotlike nodules sometimes found at the point of injection, should be classed as reactions. When both the upper and lower tests are made of animals in a herd that is known to contain infected cattle, any doubtful cases should be classed as reactors.

In addition to the swelling which is associated with a reaction, careful attention should be given to enlargement of the caudal lymphatic gland and lymphatic vessel. In observing the lower injection the lymphatic chain draining that area should also be palpated carefully for enlargement as indicated in connection with the caudal-fold observation. A reaction may occur to the lower injection, indicated by a maroon colorization of the vaginal mucous membrane on the side the injection is made. The mucous membrane in such reaction

loses its shining, glossy appearance, taking on a velvety appearance. It is necessary to press the lips of the vulva apart very gently in order to detect this maroon color.

It is important to make the upper and lower injection and carefully observe the lymphatic chains in both instances as well as to observe the vaginal mucous membrane. Sometimes the only reactions noticeable in the badly affected animal will be the enlarged lymphatics or the maroon-colored mucous membrane. Failure to give careful con-

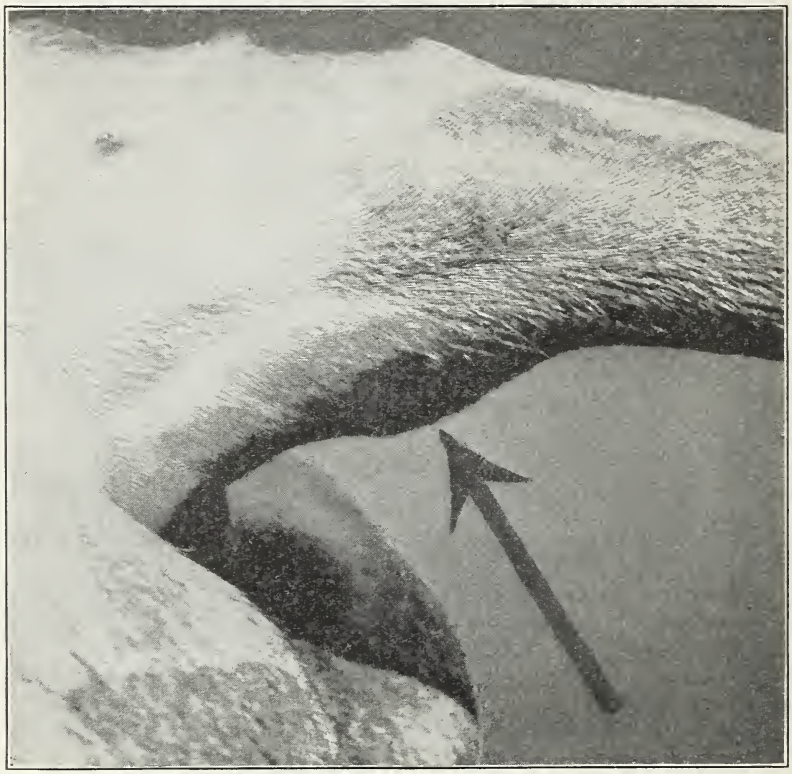

FIGURE 9.—A very pronounced reaction to the intradermic test. All swellings resulting from the injection of tuberculin by this method are not so large as indicated in the picture.

sideration to these points may result in tuberculosis being continued in a herd for a much longer period than is necessary and be a discredit to the test.

In classifying very small swellings when the lymphatic gland or the mucous membrane is not involved, the previous history of the herd relative to infection should be taken into consideration.

10. Records of complete tests should be made upon prescribed forms and the observations should be reported in accordance with the code on page 13 which, with the exception of the last two paragraphs, was adopted by the United States Live Stock Sanitary Association and approved by the Bureau of Animal Industry on December 6, 1920.

ADVANTAGES AND DISADVANTAGES

The advantages and disadvantages of the intradermic test are as follows:

Advantages.—It is equally as reliable as any other test. It facilitates the work, the operator being able to test a much larger number of cattle in a given time. Animals of all ages, dispositions, and those maintained under adverse conditions can be tested without confusing the operator. It pleases the livestock owner, especially the dairyman who is not required to confine his cattle for a very long time.

Disadvantages.—Its apparent simplicity may induce carelessness on the part of a veterinarian not thoroughly trained and experienced. The injection is a delicate operation, and unless the cattle are properly restrained it is not very easily accomplished.

The question frequently arises as to the possible interference of a previous subcutaneous test with the intradermic test, or a succeeding subcutaneous test following an intradermic injection. It is believed that there is an influence of one upon the other and it is, therefore, desirable to permit at least 60 days to elapse after an animal has been tested by the subcutaneous method.

THE INTRADERMIC-TEST CODE

Animals showing no reaction shall be recorded at each observation as N (negative).

Reactors shall be recorded as follows:

For circumscribed swellings "pea" size (diameter three-sixteenths of an inch) shall be used as the basic standard. Larger swellings shall be reported as "P2", "P3", "P4", "P5", etc.; the figures 2, 3, 4, and 5 referring to two, three, four, and five times the size of a pea.

For diffused swellings "thick 2 X" shall be used as the basic standard and signifies a diffuse swelling in which the injected caudal fold is twice as thick as the normal fold. Larger swellings shall be recorded as "thick 3 X", "thick 4 X", etc.

When the lymphatic chain of the caudal fold is enlarged such a disturbance should be indicated CL.

In case the vaginal lymphatic chain is enlarged it should be reported on the chart as VL. Maroon-colored vaginal mucous membrane should be reported on the test chart as VM.

THE OPHTHALMIC TEST

The ophthalmic test is seldom used, and, as previously stated, is not recognized by the Bureau of Animal Industry as an official test. It is made by treating the eye with a specially prepared liquid tuberculin or by the use of tuberculin disks. This test was used experimentally in a number of the States and by the Bureau of Animal Industry for several years.

DIRECTIONS FOR APPLYING

1. The left eye is used for the instillation of the tuberculin whether it be in disk or liquid form, and the right eye is used as the control. The herd should be observed closely, and if sore eyes are prevalent the cattle should not be tested by the ophthalmic method.

2. The best results are produced when a sensitizing instillation is made 3 to 6 hours prior to the instillation of the diagnostic dose.

3. The tuberculin is usually placed under the left upper lid and when the disk is used it is gently held in place for about one-half minute.

4. Make observations following the placing of the sensitizing agent, if possible, commencing at about the second hour and repeating them every 2 hours for not less than 8 hours. These preliminary observations are desirable, although not essential.

5. Observations, following the placing of the diagnostic agent, must begin at the second hour and continue at not to exceed 2-hour intervals up to the eighth hour or longer. More frequent observations may be made of badly infected herds; some animals are very slow in responding to the test.

6. Reactions are indicated usually by lachrymation and redness of the conjunctiva, possibly swelling, and a free discharge of mucopurulent pus. This typical discharge should not be confused with an occasional mucous discharge sometimes seen at the inner canthus as a result of the introduction of any foreign material. Occasionally a tuberculin disk may cause this slight, faint, mucous discharge of whitish appearance, especially if the tuberculin disks have not been properly placed.

POST-MORTEM EXAMINATION OF REACTING CATTLE

It is important that tuberculosis be disclosed in animals which have reacted to tuberculin. The predominant idea of endeavoring to show a reasonable percentage of visible lesions is based upon the knowledge that cattle owners for whom the work is done are much better satisfied to know that infection was found after the animals had been condemned. It is not desirable to disclose lesions for the purpose of basing the accuracy of the tuberculin test upon the autopsy findings. It is fully appreciated that a certain percentage of animals, with lesions of a very obscure nature that would be overlooked in ordinary routine examination, will react to tuberculin. Nevertheless every veterinarian should familiarize himself with the technique of conducting a post-mortem examination. A vast majority of the members of the profession probably know the primary seats of tuberculous infection. There is the possibility, however, of tuberculous foci being found in obscure or isolated organs or glands. Much work has been done in investigating so-called "no-lesion" cases in tuberculin reactors. It was found that a much larger number of skin lesions were present than had been supposed. For instance, it was found that during a previous 3-month period when an extensive study was made of this class of lesions, approximately 2½ percent of the 20,683 reacting cattle slaughtered under official inspection showed skin lesions only. It is further known that many cases of early infection will react in which it will be hard to disclose lesions even of microscopic size. Further, it should be remembered that a lesion microscopic in character will produce a reaction and that it would be impossible to disclose foci of this size in the carcass of an average-sized animal. Records compiled by the Bureau show that

over 50 percent of the so-called no-lesion cases are from herds in which infection is known to exist.

Further information on this subject is given in Circular No. 32, The Regional Lymph Glands of Food Animals, issued by the United States Department of Agriculture.

NECESSARY WORK FOLLOWING TUBERCULIN TESTING

One of the most important phases of tuberculosis-eradication work is the attention given to herds after the tuberculin test has been completed, especially those in which infection is found. Histories of herds in which infection continues to exist or in which infection recurs too often points to, and is the result of, failure to adopt the necessary sanitary measures or to guard against the entrance of infected cattle. No test should be regarded as completed until the owner has been fully advised of all the possible agencies which might at times prevent the establishment and maintenance of tuberculosis-free herds. Following are the essential safeguards:

All reactors should be identified and immediately removed from the herd or properly segregated until such time as they can be disposed of in accordance with the State regulations.

The premises occupied by diseased cattle should be immediately cleaned and disinfected under proper supervision.

No cattle should be added to the herd without having satisfactorily passed a tuberculin test.

The cattle of the herd should not be permitted to associate with other cattle except those that have passed a satisfactory tuberculin test.

Building alterations should be made to permit the housing of the herd under proper sanitary precautions.

Special attention should be given to watering troughs, some types of which, even individual receptacles, have been found to be prolific spreaders of tuberculosis. Ponds to which diseased cattle have access are sources of danger.

In States in which tuberculosis has not been eradicated the feeding of calves and swine with unpasteurized products from herds containing diseased cattle or from creameries should not be permitted. The question of tuberculosis in either swine or poultry should be thoroughly looked into and necessary steps taken to guard the herd or flock.

A herd from which the reactors are removed should be retested within about 60 days, using both the upper and lower injections.

The advantage to be derived from advising the owner along the lines indicated are clearly shown by the history of numerous herds which have been freed of disease and which have been maintained under sanitary conditions. Figure 10 shows the interior of a modern sanitary dairy barn. When maintained under conditions like these after being established as free of disease the herd should always normally remain in that condition.

TUBERCULIN TESTING OF SWINE AND FOWLS

Tuberculosis of swine and poultry is very troublesome in certain hog-raising States of the Middle West.

It is common knowledge that swine easily become infected through the ingestion of germ-laden feed. Feeding tuberculous carcasses or slaughter-house offal to hogs is a common source of infection. It is also believed that a certain proportion of diseased swine contract tuberculosis by eating uncooked garbage. The rapid growth of the area plan of eradicating bovine tuberculosis has also demonstrated that a certain percentage of infection in swine can be traced to tuberculous poultry.

It will be readily seen that the sources of infection are sufficiently constant to maintain the already very high percentage of tuberculosis known to exist in swine. It is therefore deemed advisable to test all breeding animals maintained on premises where tuberculosis is known to exist or where such swine have access to possible infected material.

FIGURE 10.—Interior of a model sanitary dairy barn. Note cleanliness of stable and cows.

In the event that tuberculosis is found in any of the swine on a farm, the entire herd had better be sold for slaughter unless the breeding stock is too valuable. In such a case the animals should be tested and the disease-free animals removed to clean ground.

The best method of testing swine is the intradermic, the injection being made into the lip of the vulva or the skin near the base of one ear. Observations should be made in accordance with instructions for the test as it pertains to cattle. Removal of reactors and cleaning and disinfecting should be practiced if the tuberculosis eradication is to be a success.

Poultry may become affected with tuberculosis when kept in badly contaminated yards. The disease is more commonly found in birds that are more than 1 year old, but is sometimes found also in young birds. The common symptoms are ravenous appetite and general emaciation, with wasting of the flesh on the breastbone.

Diagnosing tuberculosis in flocks of valuable birds is best done by means of the intradermic test. This test is made by injecting a small quantity of avian tuberculin into the skin of one wattle of a fowl or into the skin of the vent. A swelling at the point of injection at the end of 48 hours indicates the presence of tuberculosis.

Further information regarding tuberculosis of poultry or swine may be obtained from Leaflet 102, Eradicating Tuberculosis from Poultry and Swine, issued by the United States Department of Agriculture.

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U. S. GOVERNMENT PRINTING OFFICE: 1940

Circ. 249—254760°—40

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